



R2D2

Reliability, Resilience and Defense
technology for the grid



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Workshop on Pilot Sites

08.07.2025



Reliability of energy assets through advanced inspection techniques (The Portuguese Pilot)

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**Reliability, Resilience and
Defense technology for the grid**

Current Pilot Information: Portugal

- EDP NEW – Pilot Coordinator



- E-Redes – Pilot Host



- Labelec – Affiliated Entity



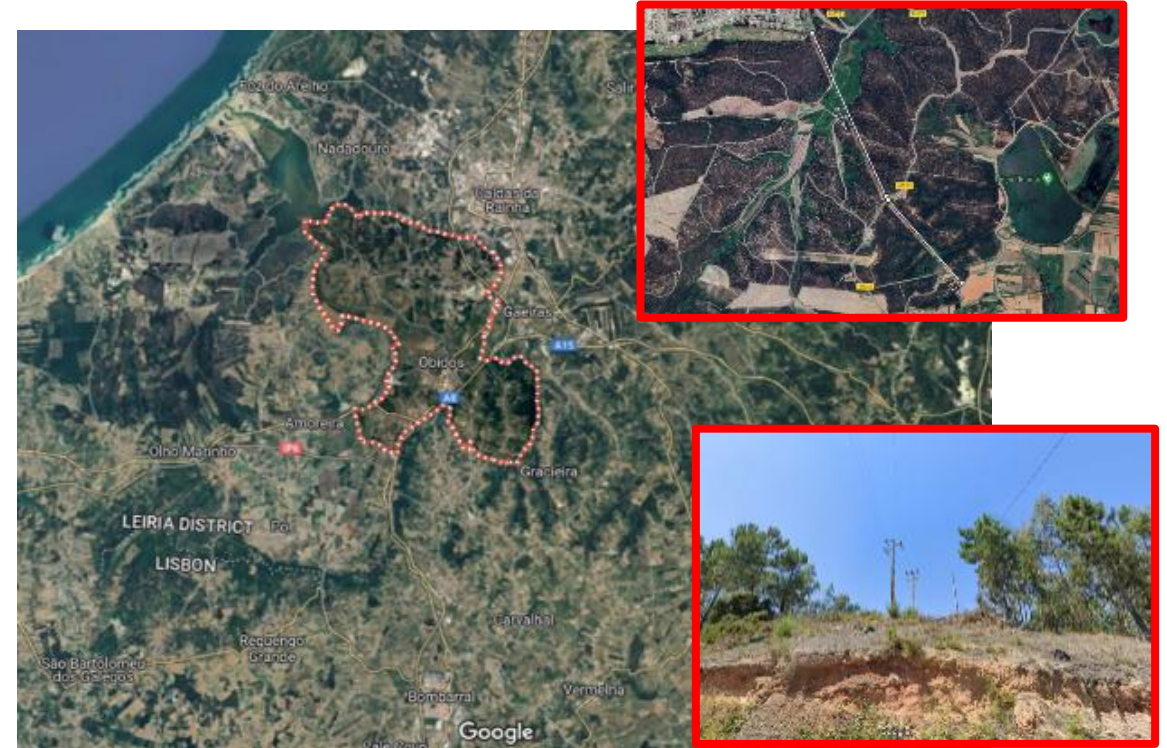
- Pilot Location: Portugal (2 locations: MV Overhead line (Óbidos), Substation (Almeirim))

Overall Pilot Needs and Objectives

- Enhance drone's inspection
- Reduction of outages.
- Reduction of maintenance costs.

The Portuguese Pilot – ASSET #1 Infrastructure

- A 30 kV overhead MV line located in Óbidos, a city in the Leiria district.
 - This line spans a length of about 69 km, around 45km of overhead line, with a significant portion passing through rural areas.
 - The number of inhabitants supplied by this infrastructure are 2600 (15500 for the entire substation).
- **This asset is related to EMMA ARGOS Tool**





The Portuguese Pilot – ASSET #1 Infrastructure



Figure: The primary substation of the OH MV line in Óbidos town in the district Leiria.



Figure: a segment of the line passing through a forest.



The Portuguese Pilot – ASSET #2 Infrastructure

- The substation is located in Almeirim , a highly semi-urbanized city in Santarém district.
- This substation has two 60/30 kV Transformers (30 MVA).
- The substation is feeding a semi-urbanized city. It has overhead and underground lines.
- The number of inhabitants supplied by this infrastructure are 3000 residential customers and around 30 business clients.
- **This asset is related to EMMA SURVEILANCE and EMMA DYML Tool**





The Portuguese Pilot – ASSET #2 Infrastructure



Figure: Almeirim substation: components from inside the substation.



Figure: Almeirim substation: components from inside the substation.



UC1 – Overhead Power Line Inspection with EMMA ARGOS

Context

- Power grids are expanding and becoming more complex, increasing the burden on inspection and maintenance.
- Overhead lines are vulnerable to faults, vegetation interference, and environmental wear.
- Traditional inspection methods are slow, costly, and risky, especially in remote or hazardous areas.

Problem

- Manual inspections are labor-intensive, error-prone, and limited in coverage (5–16 km/day).
- Data analysis is slow and reactive, leading to delayed maintenance and increased risk of outages.
- Lack of predictive tools results in unplanned corrective maintenance and reduced grid resilience.



UC1 – Overhead Power Line Inspection with EMMA ARGOS

Solution

- EMMA ARGOS enables UAV-based autonomous inspections, capturing RGB, IR, and LiDAR data.
- AI-driven analysis identifies anomalies and prioritizes maintenance actions.
- Inspects 30–50 km/day at ¼ the cost of manual methods, with higher accuracy and safety.
- Predictive maintenance aligned with CER Directive Article 13 by enabling early detection and proactive intervention.

Vegetation encroachment

ARGOS v0.6.35 Vegetation > Portugal 1 > Inspection 11/05/25 Admin etra

Vegetation 4

- Portugal 1 3
 - 18/5/2025, 00:00
 - 11/5/2025, 00:00
 - 4/5/2025, 00:00
- Portugal 2 2
- Portugal 3 4
- Portugal 4 2

Summary

Distance	0
Towers	3
Incidents	5
HIGH	3.90 m
SEVERE	2.75 m
HIGH	3.08 m
SEVERE	2.74 m
HIGH	3.74 m

GENERATE REPORT 0

The 3D visualization shows a yellow tower with red vegetation encroachment on a dark terrain. A red line indicates the distance from the tower to the vegetation.



Structural anomalies

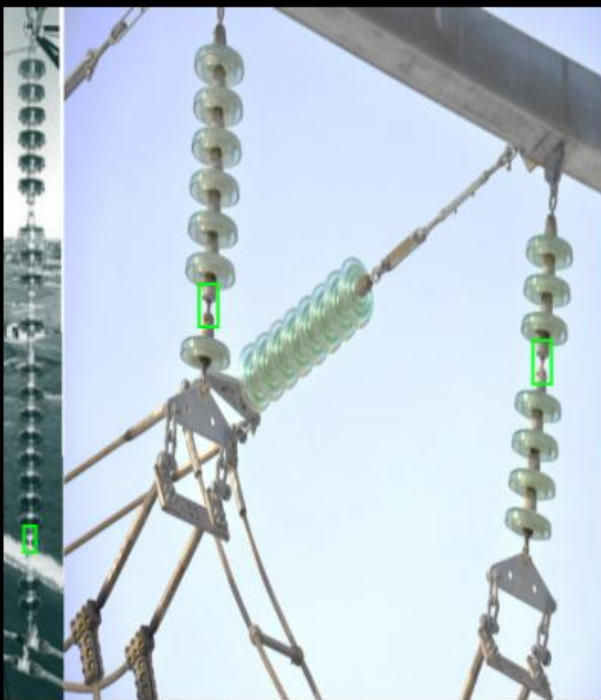
ARGOS v0.6.35 Powerlines > Portugal 5 > Inspection 04/05/25 Admin etra

Powerlines 5 PHOTOS ANOMALIES

> Portugal 1 2
> Portugal 2 2
> Portugal 3 1
> Portugal 4 1
▼ Portugal 5 3
 20/5/2025, 10:00
 4/5/2025, 00:00
 4/5/2025, 00:00

Map: Estrada das Favacas

Verified test_1.jpg



Anomaly type Insulators

Hotspots 2

> AP0110 1
▼ AP0100 1
 ! Detections 3

Thermal anomalies

The screenshot displays the ARGOS v0.6.35 interface for monitoring powerlines. The breadcrumb navigation shows 'Powerlines > Portugal 4 > Inspection 04/05/25'. The sidebar on the left lists five powerline regions: Portugal 1 (2), Portugal 2 (2), Portugal 3 (1), Portugal 4 (1), and Portugal 5 (3). The 'ANOMALIES' tab is active, showing a map with a selected powerline segment. The central panel displays a thermal image of a powerline tower with a temperature reading of 24°C. The right-hand panel shows a 'Hotspots' list with 156 total items, including a 'Detections' sub-section with 1 item.

Powerlines	Count
Portugal 1	2
Portugal 2	2
Portugal 3	1
Portugal 4	1
Portugal 5	3

Hotspots	Count
AP0048	1
AP0050	1
Detections	1
AP0052	5
AP0053	2
AP0057	1
AP0079	4
AP0061	5
AP0063	4
AP0065	2
AP0067	1
AP0068	2
AP0069	2
AP0070	2
AP0071	1
AP0072	6
AP0073	3
AP0074	4
AP0075	4
AP0076	4
AP0077	4
AP0078	6



UC6 – Substation Component Degradation Detection with EMMA SURVEILLANCE and EMMA DYML

Context

- Substations are critical infrastructure with components designed for 50+ years of operation.
- Regular inspections are essential to ensure reliability, but current methods are manual and periodic.
- Digital substations and AI offer opportunities for smarter, real-time monitoring.

Problem

- Manual inspections are time-consuming, require skilled personnel, and often involve travel to remote sites.
- Lack of real-time monitoring increases the risk of unexpected failures and blackouts.
- Current practices do not support predictive maintenance or continuous surveillance.



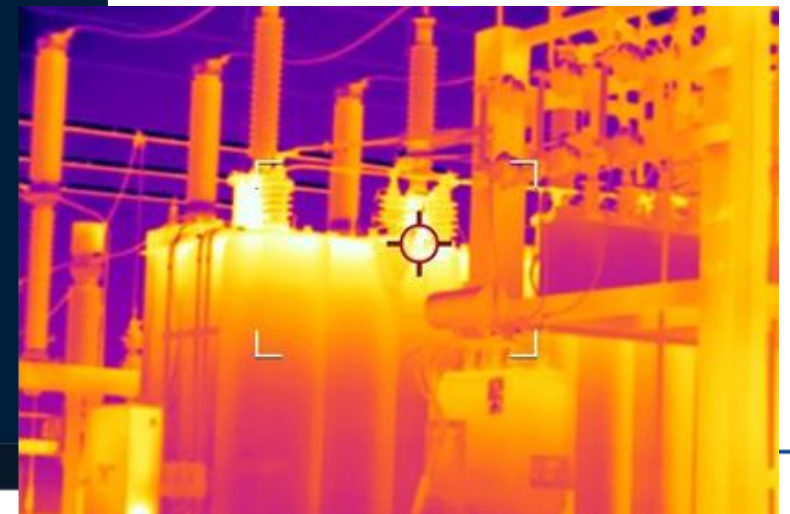
UC6 – Substation Component Degradation Detection with EMMA SURVEILLANCE and EMMA DYML Solution

- EMMA DYML uses fixed or mobile cameras to capture thermal images.
- Enables predictive maintenance by AI-modelling the normal behaviour, comparing it with current evolution, flagging high-risk components and integrating results with scheduling tools.
- EMMA SURVEILLANCE AI models detect anomalies like wildfire, smoke, presence of animals, or unauthorized access, and warns operator accordingly.
- Supports CER Directive Article 13 by enhancing physical protection, monitoring, and early detection capabilities.

Thermal camera hotspot detection in substation

Incidents / Anomalies			
Bushing	16.23	0s - 21s	●
Bushing	21.53	0s - 21s	●
Core	15.87	0s - 21s	●
Bushing	16.23	0s - 21s	●
Bushing	21.53	0s - 21s	●
Core	15.87	0s - 21s	●

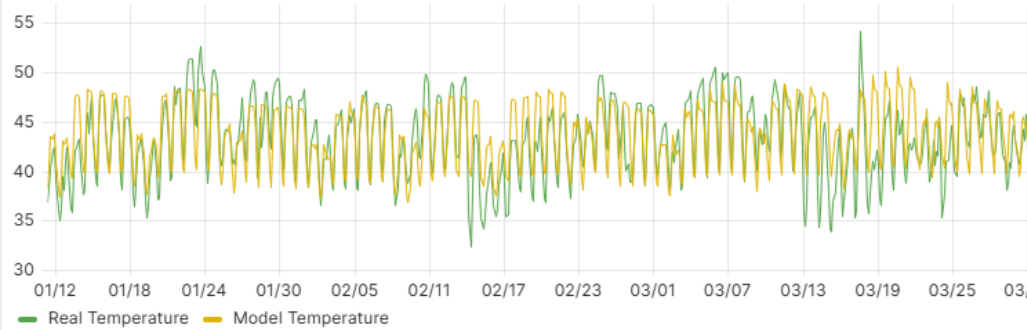
- Detects and alerts when substation components overheat
- Store thermal measurement for further thermal analysis preventive maintenance



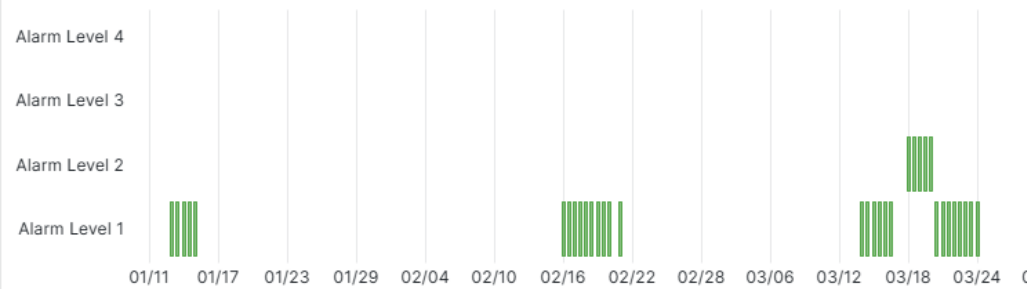


Substation preventive maintenance based on temperature

Transformer Temperatures

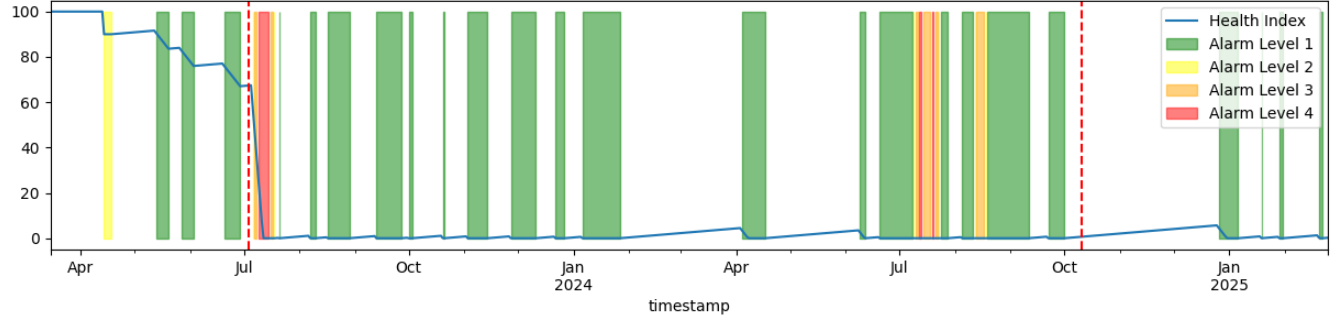
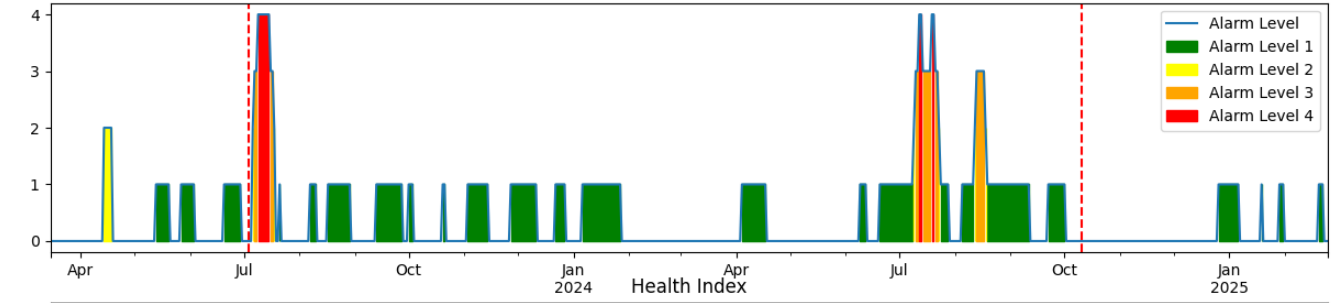
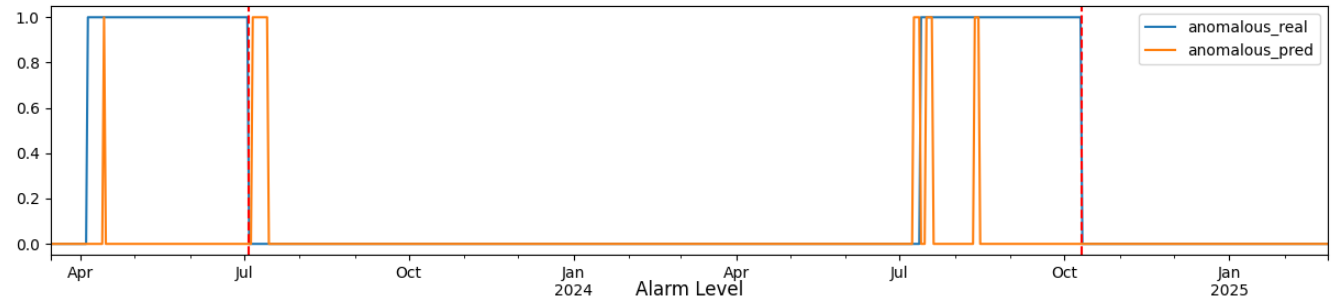


Alarm Status



- AI-based health index creation for allowing preventive maintenance on transformers (triggering alarms)

Anomalous Real vs Anomalous Predicted





THANK YOU!

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